

**TECHNICAL SPECIFICATION FOR 11 M. LONG 400 KG. WORKING LOAD
PCC POLES (F.O.S. = 2.5).**

1.0 **SCOPE:**

This specification covers pre-stressed concrete poles suitable for use in 33 KV & 11KV etc. Overhead Power lines and conforming to IS: 1678:1998 (and its amendments thereof).

2.0 **APPLICABLE STANDARDS:**

Except when they conflict with specific requirements in this Specification, the PCC poles shall comply with the relevant provisions made in the following Indian Standards or the latest versions thereof.

- a) IS: 1678, Specification for pre-stressed concrete poles for overhead power, traction and telecommunication lines.
- b) IS: 2905, Method of test for concrete poles for overhead power and telecommunication lines.
- c) IS: 7321, Code of practice for selection, handling and erection of concrete poles for overhead power and telecommunication lines.
- d) IS: 1343, Code of practice for pre-stressed concrete.
- e) IS: 456, Code of practice for Plain and reinforced concrete.
- f) IS 6003, Code of practice for HT Wire for pre-stressed concrete.
- g) IS: 383, Code of practice for aggregates used for manufacture of PCC Poles.

3.0 **TERMINOLOGY:**

For the purpose of this specification, following definitions shall apply: -

3.1 **AVERAGE PERMANENT LOAD**

That fraction of the working load which may be considered of long duration over a period of one year.

3.2 **LOAD FACTOR**

The ratio of ultimate transverse load to the transverse load at first crack.

3.3 **TRANSVERSE**

The direction of the line bisecting the angle contained by the conductor at the pole. In the case of a straight run, this will be normal to the run of the line.

3.4 **TRANSVERSE LOAD AT FIRST CRACK**

For design, the transverse load at first crack shall be taken as not less than the value of the working load.

3.5 **WORKING LOAD**

The maximum load in the transverse direction, that is ever likely to occur, including the wind pressure on the pole. This load is assumed to act at a point 600 mm below the top with the butt end of the pole planted to the required depth as intended in the design.

3.6 **ULTIMATE FAILURE**

The condition existing when the pole ceases to sustain a load increment owing to either crushing of concrete, or snapping of the pre-stressing tendon or permanent stretching of the steel in any part of the pole.

3.7 **ULTIMATE TRANSVERSE LOAD**

The load at which failure occurs, when it is applied at a point 600 mm below the top and perpendicular to the axis of the pole along the transverse direction with the butt end of the pole planted to the required depth as intended in the design.

4.0 **GENERAL:**

- 4.1 Solid sections pre-stressed cement concrete poles shall be suitable for use in overhead 33KV & 11KV lines and suitable for a working load of 400 KG. applied in transverse direction at a distance of 600 mm. below top. The Overall length of the pole shall be 11 M. having depth of plantation as 1.80 Mtr. suitable for plantation direction into ground, when used in straight-line position. The structural strength of pole in longitudinal direction shall be at least one fourth of the strength in transverse direction. The average permanent load is 40% of working load.

For earthing G.I wire 8 SWG shall be embedded with projecting length of 175 mm. at 300 mm. from top and 175 mm. at 1650 mm. from bottom/butt end of PCC Poles. Earth wire shall not be allowed to come in contact with HT wire. The pole shall conform to IS: 1678-1998, IS: 1343-1980 and IS: 456-2000. (Or their latest editions/revisions thereof)

Two numbers through holes of 18-mm. dia. on the broader longitudinal side of the poles in the direction of conductor to be laid normal to and shall be provided such that the centers of these holes are at a distance of 100 mm. and 200 mm. from the top of poles.

Apart from above, necessary **lifting hooks** made of triple wire 4 mm dia at four locations, 1.80 mtr. and 3.60 mtr. from butt end & 2.25 mtr. and 4.5 mtr. from top end. (To be mentioned in the drawing) may also be provided.

5.0 **MATERIAL:**

5.1 **CEMENT:**

The cement used in the manufacture of prestressed concrete poles shall be any of the following: -

- a) Portland slag cement conforming to IS: 455 but with not more than 50 percent slag content.
- b) Rapid hardening Portland cement conforming to IS: 8041.
- c) 43 Grade ordinary Portland conforming to IS: 8112 and

d) 53 Grade ordinary Portland cement conforming to IS: 12269.

5.2 **AGGREGATES:**

Aggregates used for manufacture of prestressed concrete pole shall conform to IS: 383:1970(latest amendments thereof). If required a sample of the aggregates shall be submitted by the manufacturer to the purchaser for approval. The maximum size of the aggregate shall in no case exceed 20 mm.

5.3 **WATER:**

The water used for concrete mixing and curing shall be clean and free from organic and inorganic matter harmful to concrete. Potable water shall be generally suitable.

5.4 **ADMIXTURE:**

The use of admixture is not generally recommended. These may be used only with the approval of the purchaser based on evidence that with the passage of time neither the compressive strength of concrete is reduced by more than 10% nor are other requisite qualities of concrete and/or steel impaired by the use of such admixtures. The admixture shall conform to IS: 9103. Admixture should not contain calcium chloride or other chlorides or other salts which are likely to cause corrosion of pre-stressing steel.

5.5 **PRESTRESSING STEEL (High Tensile Steel):**

High tensile steel used for manufacture of prestressed concrete poles shall conform to IS: 1785 or IS: 2090 or IS 6003-1983 (latest amendments thereof). The Pre-stressing steel shall be free from splits, harmful scratches surface flaws, rough rust, scale and other similar deleterious matter liable to affect adversely proper tensioning or its bond with concrete. The diameter of smooth wire used for prestressing of poles shall be 4 mm. or 5-mm. dia. or a combination of two sizes and its ultimate tensile strength shall not be less than 175 Kg/mm² for 4 mm wire & 160 Kg/mm² for 5 mm dia wire.

5.6 **OTHER REINFORCEMENT:**

Apart from the high tensile steel provided for prestressing the poles, 6mm. dia plain round M.S Bar or 4mm.dia. H.T. Wire stirrups (as per IS: 432 or IS: 1786) shall be provided 4 Nos. at each end and 4 Nos. in the mid portion uniformly distributed (to be shown in the drawing). Un-tensioned reinforcement, if any, as required in design shall also be shown in drawing.

The surface of reinforcement shall be free from loose scale, oil, grease, clay or other material that may have degenerating affect on the bond between the reinforcement and concrete.

6.0 **CONCRETE:**

Design Mix. Concrete as defined in para 9.0 of IS: 456: 2000 and para 8 of IS: 1343: 1980 will be used in the manufacture of the poles. The design of concrete mix shall conform to the requirements laid down for controlled concrete under Para 9.2 of IS: 456:2000 subject to following further conditions.

a) Minimum cube strength at 28 days shall not be less than 450 Kg/cm² in accordance with acceptability criteria given in clause 16 of IS: 456:2000.

- b) The mix shall contain as low as possible water cement ratio as is consistent with adequate workability.
- c) The concrete shall be compacted thoroughly by vibration, pressure, shock, or other means and shall have a density of not less than 2.4 MT/M^3 .
- d) The cube strength of concrete at transfer of prestress shall not be less than 245 Kg/cm^2 .
- e) The supplier shall be required to maintain a register showing the test results of cubes at the age of 3 and 28 days and at the transfer of prestress. For strength test the cubes shall be taken for each days casting. The register will show the serial number and the pole cast that day for which the test will apply. The acceptability criteria will be as per Para 16.3 to 17.5 of IS: 456. The register shall be opened for inspection with the authorized representative of the Corporation.
- f) The tenderer shall give a proper mix design of the grade M 45 of design mix concrete proposed to be used for casting of pole and such mix design may be supported by the test certificate of some Govt. Lab, or other Recognized Lab. Mix design done earlier not prior to one year may be considered adequate for later work, provided there is no change in source and quality of material.

7.0 **DESIGN:**

- 7.1 The poles shall be so designed that they do not fail owing to failure initiated by compression in concrete. Maximum wind pressure to be assumed may be determined as specified in IS: 875. (Part-3).
- 7.2 The pole shall be 11 M. long and should be designed for an ultimate load of 1 MT acting at 600 mm. below top. The dimensions, reinforcement etc. required to be provided may be shown in the drawing supplied by the tenderer supported by design calculation memo.
- 7.3 The ultimate moment capacity in longitudinal direction should be atleast one fourth of that in transverse direction. The PCC Pole be designed so that it should be safe against bending, shear, torsion and axial load at various stages of loading under most unfavorable condition of loading.
- 7.4 The G.I Wire, 8 SWG, which be in one continuous length, shall be embedded in the pole for earthing purpose. No joint of any kind in this wire shall be permitted. The position and details of connection to be provided at the end of earth wire have to be shown in the drawing.
- 7.5 The position of 18 mm diameter of the holes at 100 mm and 200 mm from top shall be provided in the poles are also to be shown in the drawing and shall be centrally located and will be perpendicular to the face of the pole.
- 7.6 Factor of safety against ultimate failure is 2.5. While it is 1.0 for first crack moment. Designer should mention basis for adopting various design constants e.g. permissible tensile, compressive stress, modulus of rupture etc.
- 7.7 The poles shall be designed to be suitable for fitting stays and clamps.
- 7.8 Separate Eye hooks shall be provided for handling and transport of poles, one at each of the pole and should be on the shorter dimension of the cross section. The poles should be strong enough for lifting and erection in any direction during handling and transport. During erection, poles are laid on the ground and lifted at some point near the end, similarly while loading and unloading the poles from carriers they are lifted at one end resting on the ground and pushed on to the trucks. The poles should be able to withstand all such manual handling.

7.9 **TRANSVERSE STRENGTH AT FAILURE:**

The poles shall be designed that its strength in transverse direction shall be sufficient to take the load due to wind on wires and poles, multiplied by load factor.

8.0 **MANUFACTURE:**

The tensioning of prestressing tendons shall be carried out in a manner that will induce a smooth and even rate of increase of stress in the tendons.

8.1 The force induced in the prestressing tendon shall be determined by suitable means attached to the tensioning apparatus. It is essential that the method used to determine the initial prestress in the wire give accurate result. Each wire shall be anchored positively during casting. Prestress in each wire shall be uniform. Care must be taken to ensure that anchorage do not yield before concrete attains the desired strength.

8.2 The cover of concrete measured from the outside of the prestressing tendon shall be atleast 30 mm. or the size of the cable or bar whichever is bigger.

8.3 When measuring the prestressing force, any slip which may occur in the gripping device shall be taken into consideration.

8.4 The transfer of pre-stressed shall be carried out gradually by a proper device, so that the entire set of wires are released simultaneously.

8.5 In long line method, where the transfer is made on several moulds at a time, care shall be taken to ensure that prestressing force is evenly applied on all moulds and that the transfer of prestress to concrete is uniform along with entire length of tension line by ensuring correct alignment of moulds on guide plates.

8.6 The high tensile wire shall be continuous over the entire length of the tendon. Welding shall not be allowed in any case.

8.7 The pre-stressing wires shall be de-tensioned only after the concrete has attained the specified strength at transfer (i.e. 245 kg / cm^2). The cubes cast for the purpose of determining the strength at transfer should be cured, as far as possible, under conditions similar to those under which the poles are cured, the transfer stage shall be determined based on the daily tests carried out on concrete cubes till the specified strength indicated above is reached. Thereafter the test on concrete shall be carried out as detailed in IS: 1343 (Code of practice for pre-stressed concrete). The manufacturer shall supply, when required by the owner or his representative, result of compressive test conducted in accordance with IS: 456 (Code of practice for plain and reinforced concrete) on concrete cubes made from the concrete used for the poles. If the owner so desired, the manufacturer shall supply cubes for test purposes and such cubes shall supply cubes for test purposes and such cubes shall be tested in accordance with IS: 456 (Code of practice for plain and reinforced concrete).

8.8 The pre-tensioning shall be done by slowly releasing the wires, without imparting shock or sudden load to the poles. The rate of pre-tensioning may be controlled by any suitable means either mechanical (screw type) or hydraulic. The poles shall not be pre-tensioning or released by cutting the pre-stressing wires using flames or bar croppers while the wires are still under tension.

8.9 **COMPACTING:**

Concrete shall be compacted by vibrating, Shocking or other suitable mechanical means. Hand compaction shall not be permitted

8.10 **CURING:**

Curing to be done as specified in IS: 1678 (1998). Curing of PCC Pole be preferably done in tanks filled with water. The concrete shall be covered with a layer of sacking, canvass hessian or similar absorbent material and kept constantly wet up to the time when the strength of concrete is at least equal to the minimum strength of concrete at transfer of pre-stress. Thereafter, the pole may be removed from the mould and watered at intervals to prevent surface cracking of the unit, the interval should depend on the atmospheric humidity and temperature.

9.0 **INSPECTION / TESTING:**

- 9.1 The minimum offered number of poles for inspection/ testing should not be less than 200.
- 9.2 The PVVNL authorized representative shall be entitled for periodical checking and inspecting of the raw material to be used in entire production scheme and finished poles. The supplier's shall be bound to follow all written instructions found necessary to ensure quality control and conformity the product to the relevant standards.
- 9.3 The transverse strength test on the poles shall be performed in accordance with IS: 2905-1989 (or latest amendments thereof). The pole may be tested in either horizontal or vertical position. If tested in horizontal position, provisions shall be made to compensate for the overhanging weight of the pole. For this purpose, the overhanging position of the pole may be supported on a moveable trolley or similar device the frictional resistance of supporting devices should be separately determined and deducted from the ultimate load applied on the pole. The pole shall be rigidly fixed longitudinally at the butt end for a distance equal to agreed planting depth i.e. 1.80 Mtr. and it shall be secured firmly in place with wooden shackles with concave surface and other packing shall be placed under pole to prevent injury to butt section. The transverse load shall be applied at a point 600 mm from the top of the pole and shall be steadily and gradually increased to the design value of the transverse load at the first crack. The deflection of pole at this load shall be measured. The pulling line shall be secured around the pole at load point. Load measuring device (Dynamometer) shall be placed in a way so as to accurately measure the tension in the pulling line, the other end of which is attached to the loading equipment.
- 9.4 A pole shall be deemed not to have passed the test if hair cracks appear at a stage prior to application of 50% of the ultimate Transverse load or the hair cracks if any, produced on application of 60% of the minimum ultimate Transverse load of 1000 Kg. at 600 mm. from top do not close upon the removal or reduction of test load. The load shall then be reduced to zero and increased gradually to a load equal to the first crack load plus 10% of the minimum ultimate transverse load and held for 2 minutes. This procedure shall be repeated until the load reaches the value of 80% of the minimum ultimate transverse load and thereafter increased by 5% of the minimum ultimate transverse load until failure occurs. Each time the load is applied, it shall be held for 2 minutes. The load applied to PCC Poles at the point of failure shall be measured to nearest 5 Kgs. PCC Poles shall be deemed not to have passed the test if the observed ultimate transverse load is less than the design ultimate transverse load.
- 9.5 For the purpose of test, a lot shall consist of maximum of 200 Nos. of poles. 15 Nos. of poles out of a lot shall be tested for over all length, cross section and uprightness, and 1% of the poles of the lot shall be tested till breakage for transverse strength test amongst those taken 15 Nos. for dimensional checks. Lot with lesser number of poles will also be tested as per above criteria.

- 9.6 The poles for test shall be selected at random out of a lot.
- 9.7 A lot shall be considered as conforming to these specifications if it satisfied the following conditions:
- (A) The number of poles which do not satisfy the requirement of overall length, cross section and uprightness shall not exceed one no. out of the 15 Nos. poles tested. If the number of such poles exceeds one then all the poles in a lot shall be tested for these requirements and those not satisfying the requirement shall be rejected.
 - (B) All the poles tested for transverse strength test shall satisfy the requirement of the test. If one or more poles fail, twice the number of poles originally tested shall be taken from those already selected, and subjected to the test. If there is no failure among these poles, the lot shall be considered to have satisfied the requirements of this test.
 - (C) A pole should be deemed to have passed the transverse load test if there is no permanent set observed 10 minutes after the release of applied load of 400 Kg.
 - (D) Measurement of cover- After completion of the transverse load test, the sample poles shall be taken and checked for cover of concrete. The cover of the pole shall be measured at 3 points, 1 within 1 meter from the butt end of the pole, the second within 0.6 meter from the top and third at an intermediate point and the mean value shall be compared with specified value.
- 9.8 No payment shall be made for broken pole to the extent of 1% or more during inspection/testing out of the lot offered for the inspection.

10.0 **TOLERANCE:**

- (i) The tolerance on overall length of the pole shall be ± 15 mm.
- (ii) The tolerance on cross sectional dimensions shall be ± 5 mm.
- (iii) The tolerance on the uprightness or straightness of the pole shall be 0.5% (Measurement of uprightness or straightness of pole shall be done as per clause No. 4.2.1.1 of IS: 1678:1998).
- (iv) A tolerance of ± 15 mm is also allowed in the position of G.I Wire.
- (v) The tolerance of ± 3 mm on individual value and ± 1 mm on average value of clear concrete cover taken at 3 points is allowed.

11.0 **MARKING:**

The pole shall be clearly and indelibly engraved with the following particulars during manufacturing of PCC pole so as to easily read after erection in position.

- (a) Name of firm & Serial No. of pole at two positions (i) 400 mm below top (ii) 3.0 meters from the bottom.
- (b) P.V.V.N.L., Date, month and year of casting at a place in between name of firm as given in (a).

12.0 **SPECIAL AND IMPORTANT CONDITIONS OF THE TENDER:**

1. The Price of 11 M Long PCC Pole are **FIRM** in all respect and the tenderer must quote accordingly.
- 2- TENDERER MUST QUOTE FOR A MINIMUM OF 20% QUANTITY 11 M LONG PCC POLES, OTHERWISE THEIR TENDER SHALL NOT BE CONSIDERED.

3. FOR LOADING/UNLOADING /TRANSPORT AND INSURANCE AGAINST ALL RISKS INCLUDING INSURANCE CHARGES FOR 30 DAYS STORAGE AFTER RECEIPT OF POLES AT DESTINATION STORES /SUBSTATION HAS TO BE QUOTED IN THE FOLLOWING SLABS (I) 0-50 KM. (II) 51-100 KM. (III) 101-150 KM. (IV) 151-200 KM. (V) Above 200 KM HAS TO BE QUOTED.

NOTES: Firm situated outside PVVNL Area shall transport the PCC Poles from their works to the nearest PVVNL Area border free of cost. This can be further understood as if the nearest PVVNL Area border from the firms works is 'X' Km. & the poles have been transported for total 'Y' Km. Distance then the firm shall be given transportation charges/ Corresponding to (Y-X) Km. Only.

Incase of any ambiguity in quoting the above rates, the tender is liable to be rejected.

4. 'Proven design' as mentioned in clause No.1.2.6 of Instruction to Tenderers implies that the drawing & design calculation of 11 M Long PCC Pole should be got approved by a approved Institution.
5. Data of R/R shall be deemed to be date of delivery for dispatch by rail, the data of receipt of material in purchaser's store shall be deemed to be the date of delivery for dispatch by Road.
6. No payment shall be made for broken pole during inspection/testing out of the lot offered for inspection.
7. THE BIDDER SHOULD SIGN AND STAMP EACH PAGE OF THE BIDS ITS ANNEXURE/DOCUMENTS NECESSARILY.
8. Incase of any Inconsistency the provisions contained above shall prevail.
9. The tender part II (price part) of bidders who quote poles of cross-sections different from that mentioned in the tender specification shall not be opened.